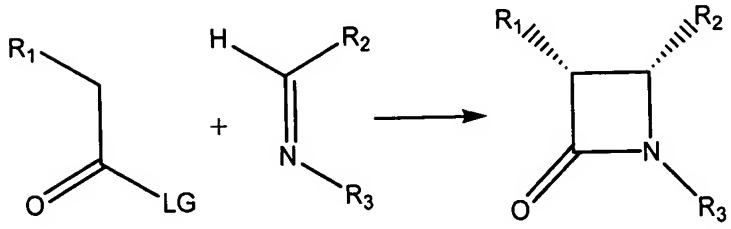
CLAIMS

What I claim is:

1. A process of preparing a beta-lactam, comprising the scheme



wherein

R_1 is hydroxyl, protected hydroxyl, thiol, or protected thiol;

LG is a leaving group;

R_2 is alkyl, alkenyl, alkynyl, or aryl where R_2 is optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms; and

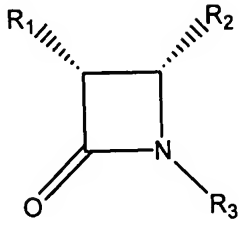
R_3 is hydrogen.

2. The process of claim 1 wherein $(R_2)(H)C=N-R_3$ is prepared by reaction between an aldehyde of the formula R_2-CHO, and an amine of the formula R_3-NH_2.

3. The process of claim 1 conducted in a chlorinated solvent.

4. The process of claim 1 wherein R_1 is phenyl and R_2 is phenyl.

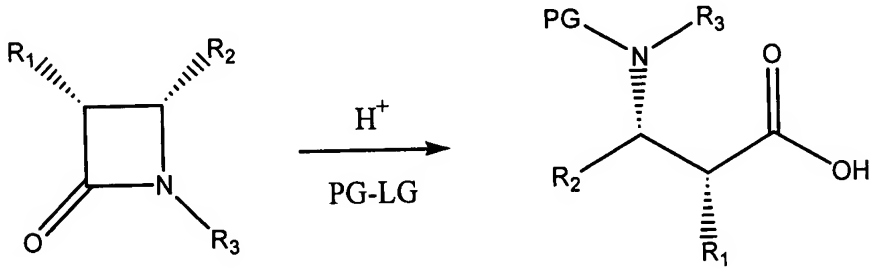
5. A compound of the formula



wherein R_1 is thiol (SH), tBOC, acetate, methoxy, thiophenyl, Cl_2CH-C(O)O- or 1-ethoxyethyl, R_2 is phenyl and R_3 is hydrogen.

6. A compound of claim 5 wherein R^1 is thiophenyl.

7. A process of opening a beta-lactam ring, comprising the scheme



wherein

R_1 is hydroxyl, protected hydroxyl, thiol, or protected thiol;

LG is a leaving group;

PG is an amino protecting group;

R_2 is alkyl, alkenyl, alkynyl, or aryl where R_2 is optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

R_3 is hydrogen, C_1-C_6 alkyl or aryl where R_3 is optionally substituted with one or more halogens, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms; and

H^+ is a proton source.

8. The process of claim 7 wherein the beta-lactam was prepared by the process of claim 1.

9. The process of claim 7 wherein the beta-lactam was prepared by the process of claim 2.

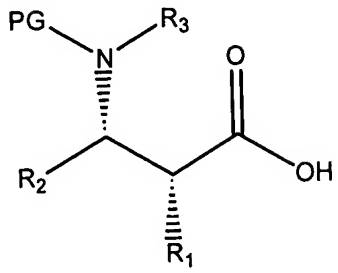
10. The process of claim 7 wherein the ring-opened product is purified by column chromatography followed by recrystallization.

11. The process of claim 10 wherein recystallization is performed with an organic solvent.

12. The process of claim 7 conducted in a mixture of organic solvent and aqueous acid.

13. The process of claim 7 wherein R_1 is thiophenyl, R^2 is phenyl, and R^3 is hydrogen.

14. An isoserine compound of the formula



wherein

R_1 is hydroxyl, protected hydroxyl, thiol, or protected thiol;

PG is an amino protecting group;

R_2 is alkyl, alkenyl, alkynyl, or aryl where R_2 is optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

R_3 is hydrogen, C_1-C_6 alkyl or aryl where R_3 is optionally substituted with one or more halogens, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

and salts and esters thereof.

15. An isoserine compound of claim 14, wherein

R_1 is hydroxyl or protected hydroxyl;

R_2 is aryl;

R_3 is hydrogen;

and salts and esters thereof.

16. An isoserine compound of claim 14, wherein

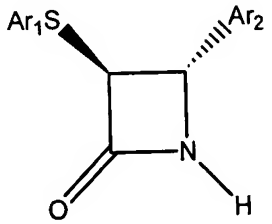
R_1 is thiol or protected thiol;

R_2 is aryl;

R_3 is hydrogen;

and salts and esters thereof.

17. A process of forming a beta lactam of the formula

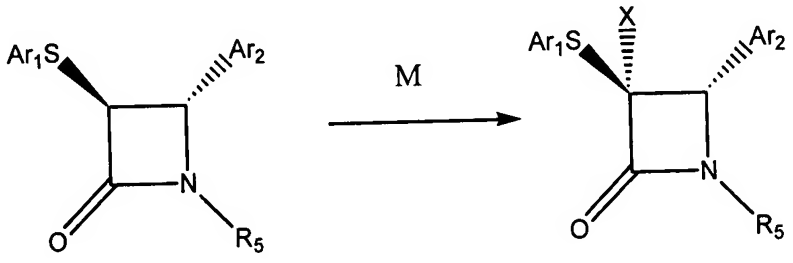


wherein Ar_1 and Ar_2 are each aryl groups, where each of Ar_1 and Ar_2 are independently optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbon atoms, and aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon atoms;

comprising reacting together compounds of the formula Ar_1S-CH_2-C(=O)Cl, NH_3, and Ar_2-CHO under conditions that form the beta lactam.

18. The process of claim 17 wherein each of Ar_1 and Ar_2 are phenyl.

19. A process comprising the scheme

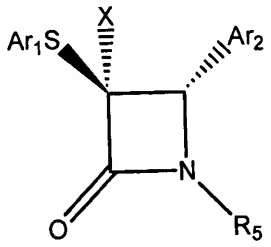


wherein Ar_1 and Ar_2 are each aryl groups, where each of Ar_1 and Ar_2 is independently optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbon atoms, and aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon atoms; X is halide; R_5 is selected from hydrogen, benzoyl and tBOC, and M is a halogenating agent.

20. The process of claim 19 wherein each of Ar_1 and Ar_2 is phenyl.

21. The process of claim 19 wherein the halogenating agent is SO_2Cl_2.

22. A compound of the formula



wherein

Ar_1 and Ar_2 are each aryl groups, where each of Ar_1 and Ar_2 are independently optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbon atoms, and aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon atoms;

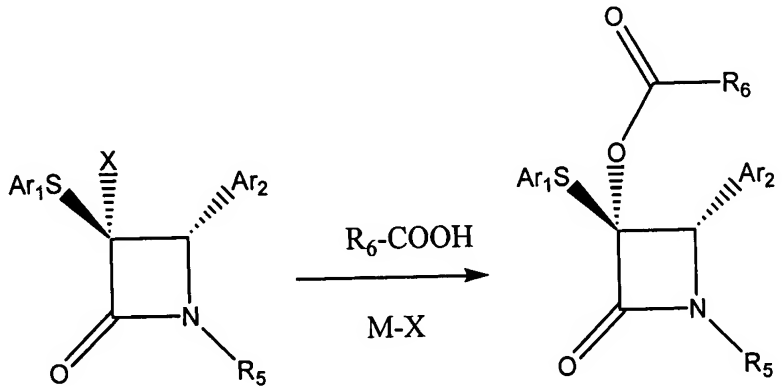
X is halide; and

R_5 is selected from hydrogen, benzoyl, tBOC, C_1-C_6 alkyl or aryl where R_5 is optionally substituted with one or more halogens, hydroxyl, alkoxy, aryloxy,

heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms.

23. A compound of claim 22 wherein Ar_1 and Ar_2 are each phenyl, X is chloride or bromide; and R_5 is hydrogen, benzoyl or tBOC.

24. A process comprising the scheme



wherein

Ar_1 and Ar_2 are each aryl groups, where each of Ar_1 and Ar_2 are independently optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbon atoms, and aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon atoms;

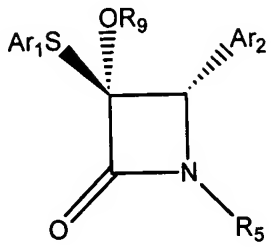
M is metal and X is one or more halides attached to the metal;

R_5 is selected from hydrogen, benzoyl and tBOC; and

R_6 is C_1-C_6 alkyl.

25. The process of claim 24 wherein Ar_1 and Ar_2 are each phenyl.

26. A compound of the formula



wherein

Ar_1 and Ar_2 are each aryl groups, where each of Ar_1 and Ar_2 are independently optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbon atoms, and aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon atoms;

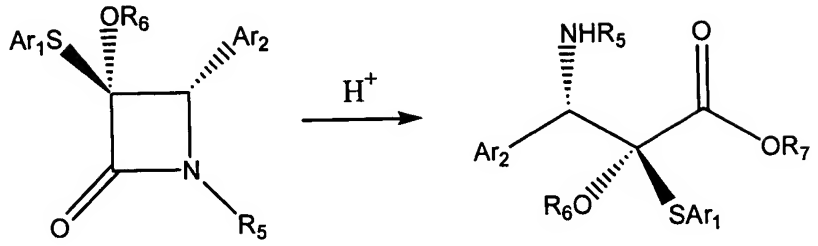
R_5 is selected from hydrogen, benzoyl and tBOC; and

R_9 is a hydroxyl protecting group.

27. The compound of claim 26 wherein R_9 is selected from methoxymethyl, methoxyethyl, 1-ethoxyethyl, benzyloxymethyl, (beta-trimethylsilyl-ethoxy)methyl, tetrahydropyranyl, 2,2,2-trichloro-ethoxycarbonyl, benzyloxycarbonyl, *tert*-butoxycarbonyl, 9-fluorenylmethoxycarbonyl, 2,2,2-trichloroethoxymethyl, trimethylsilyl, triethylsilyl, tripropylsilyl, dimethylethylsilyl, dimethyl(t-butyl)silyl, diethylmethylsilyl, dimethylphenylsilyl, diphenylmethylsilyl, acetyl, chloroacetyl, dichloroacetyl, trichloroacetyl and trifluoroacetyl.

28. The compound of claim 26 wherein Ar_1 and Ar_2 are each phenyl.

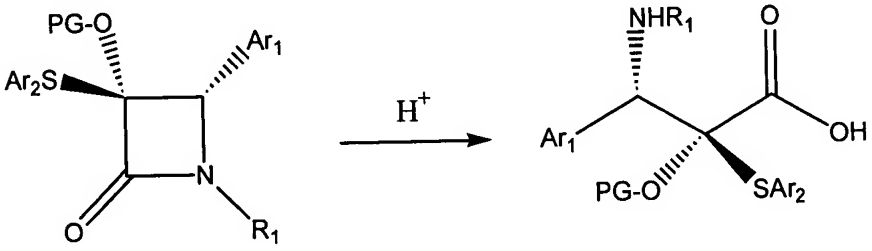
29. A process comprising the scheme



wherein Ar_1 and Ar_2 are aryl groups independently selected at each occurrence, R_5 is selected from hydrogen, benzoyl and tBOC, R_6 is a hydroxy protecting group, and R_7 is hydrogen or C_1-C_6alkyl.

30. The process of claim 29 wherein Ar_1 and Ar_2 are each phenyl.

31. A process of opening a beta lactam according to the scheme



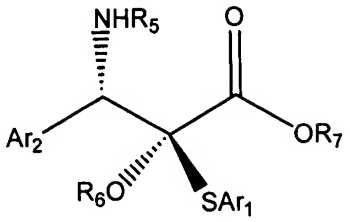
wherein

PG is a hydroxyl protecting group;

Ar_1 and Ar_2 are each aryl groups, where each of Ar_1 and Ar_2 are independently optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbon atoms, and aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon atoms;

R_1 is hydrogen, alkyl, or –O-PG wherein PG is a protecting group.

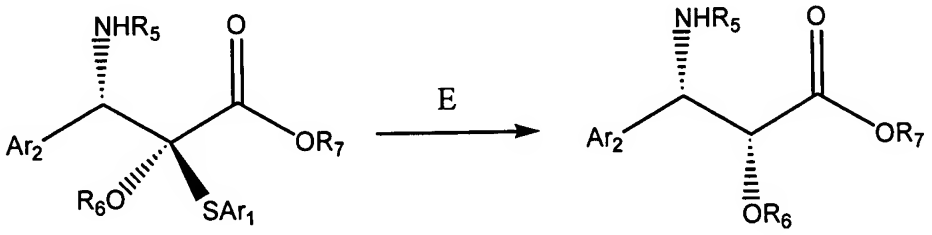
32. A compound of the formula



wherein Ar_1 and Ar_2 are aryl groups independently selected at each occurrence, R_5 is selected from hydrogen, benzoyl and tBOC, R_6 is a hydroxyl protecting group, and R_7 is hydrogen or C_1-C_6alkyl.

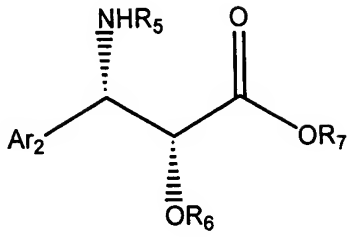
33. The compound of claim 32 wherein R_6 is selected from methoxymethyl, methoxyethyl, 1-ethoxyethyl, benzyloxymethyl, (beta-trimethylsilyl-ethoxy)methyl, tetrahydropyranyl, 2,2,2-trichloro-ethoxycarbonyl, benzyloxycarbonyl, *tert*-butoxycarbonyl, 9-fluorenylmethoxycarbonyl, 2,2,2-trichloroethoxymethyl, trimethylsilyl, triethylsilyl, tripropylsilyl, dimethylethylsilyl, dimethyl(t-butyl)silyl, diethylmethylsilyl, dimethylphenylsilyl, diphenylmethylsilyl, acetyl, chloroacetyl, dichloroacetyl, trichloroacetyl and trifluoroacetyl.

34. A process comprising the scheme



wherein Ar_1 and Ar_2 are aryl groups independently selected at each occurrence, R_5 is selected from hydrogen, benzoyl and tBOC, R_6 is C_1-C_6 alkyl, R_7 is H or C_1-C_6 alkyl, and E represents a desulfuration reagent.

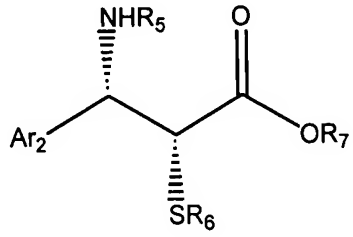
35. A compound of the formula



wherein Ar_2 is an aryl group R_5 is selected from hydrogen, benzoyl and tBOC, R_6 is a hydroxyl protecting group, and R_7 is H or C_1-C_6 alkyl.

36. The compound of claim 35 wherein R_6 is selected from methoxymethyl, methoxyethyl, 1-ethoxyethyl, benzyloxymethyl, (beta-trimethylsilyl-ethoxy)methyl, tetrahydropyranyl, 2,2,2-trichloro-ethoxycarbonyl, benzyloxycarbonyl, *tert*-butoxycarbonyl, 9-fluorenylmethoxycarbonyl, 2,2,2-trichloroethoxymethyl, trimethylsilyl, triethylsilyl, tripropylsilyl, dimethylethylsilyl, dimethyl(t-butyl)silyl, diethylmethylsilyl, dimethylphenylsilyl, diphenylmethylsilyl, acetyl, chloroacetyl, dichloroacetyl, trichloroacetyl and trifluoroacetyl.

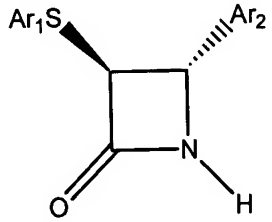
37. A compound of the formula



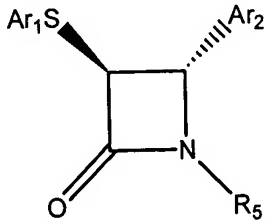
wherein Ar_2 is an aryl group R_5 is selected from hydrogen, benzoyl and tBOC, R_6 is a thiol protecting group, and R_7 is H or C_1-C_6 alkyl.

38. The compound of claim 37 wherein the thiol protecting group is triphenylmethyl (trityl, Trt), acetamidomethyl (Acm), benzamidomethyl, 1-ethoxyethyl or benzoyl.

39. A process of substituting the nitrogen of a beta lactam, comprising treating a beta lactam of the structure



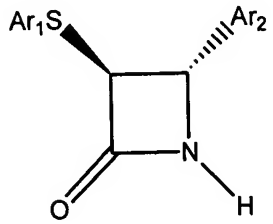
with a base and a protecting agent, to provide a beta lactam of the structure



wherein Ar_1 and Ar_2 are aryl groups independently selected at each occurrence, and R_5 is selected from benzoyl and tBOC.

40. The process of claim 39 wherein the protecting agent is benzoyl chloride or di-tert-butyl-dicarbonate

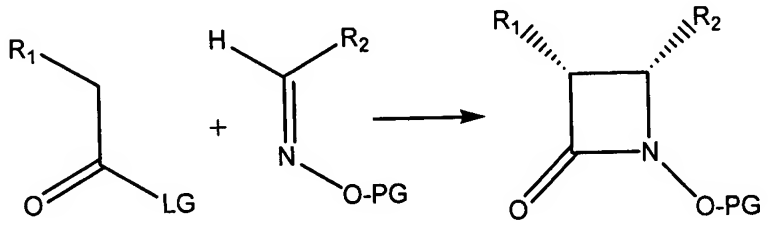
41. The process of claim 39 proceeded by forming a beta lactam of the formula



by a process comprising reacting together compounds of the formula Ar_1S-CH_2-C(=O)Cl, base, and Ar_2-CHO under conditions that form the beta lactam.

42. The process of claim 41 wherein the base is ammonia.

43. A process for preparing a beta lactam, comprising the scheme



wherein

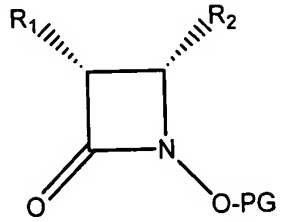
R_1 is hydroxyl, protected hydroxyl, thiol, or protected thiol;

LG is a leaving group;

R_2 is alkyl, alkenyl, alkynyl or aryl, where R_2 may be optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms; and

PG is a protecting group.

44. A compound of the formula



R_1 is hydroxyl, protected hydroxyl, thiol, or protected thiol;

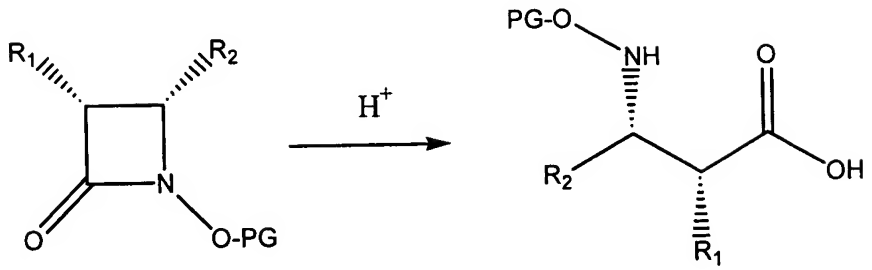
R_2 is alkyl, alkenyl, alkynyl or aryl, where R_2 may be optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms; and

PG is a protecting group.

45. The compound of claim 44 wherein R_1 is a protected hydroxyl group and the protecting group is selected from methoxymethyl, methoxyethyl, 1-ethoxyethyl, benzyloxymethyl, (beta-trimethylsilyl-ethoxy)methyl, tetrahydropyranyl, 2,2,2-trichloro-ethoxycarbonyl, benzyloxycarbonyl, *tert*-butoxycarbonyl, 9-fluorenylmethoxycarbonyl, 2,2,2-trichloroethoxymethyl, trimethylsilyl, triethylsilyl, tripropylsilyl, dimethylethylsilyl, dimethyl(t-butyl)silyl, diethylmethylsilyl, dimethylphenylsilyl, diphenylmethylsilyl, acetyl, chloroacetyl, dichloroacetyl, trichloroacetyl and trifluoroacetyl.

46. The compound of claim 44 wherein R_1 is a protected thiol group, and the protecting group is selected from triphenylmethyl (trityl, Trt), acetamidomethyl (Acm), benzamidomethyl, 1-ethoxyethyl and benzoyl.

47. A process comprising the scheme

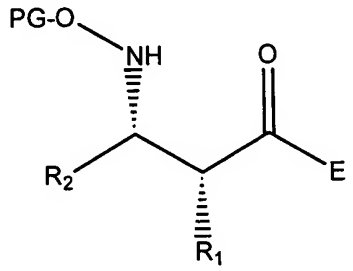


R_1 is hydroxyl, protected hydroxyl, thiol, or protected thiol;

R_2 is alkyl, alkenyl, alkynyl or aryl, where R_2 may be optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms; and

PG is a protecting group.

48. A compound of the formula



R_1 is hydroxyl, protected hydroxyl, thiol, protected thiol, alkyl, alkenyl, alkynyl, or aryl where R_1 is optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20

carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

R_2 is alkyl, alkenyl, alkynyl or aryl, where R_2 may be optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

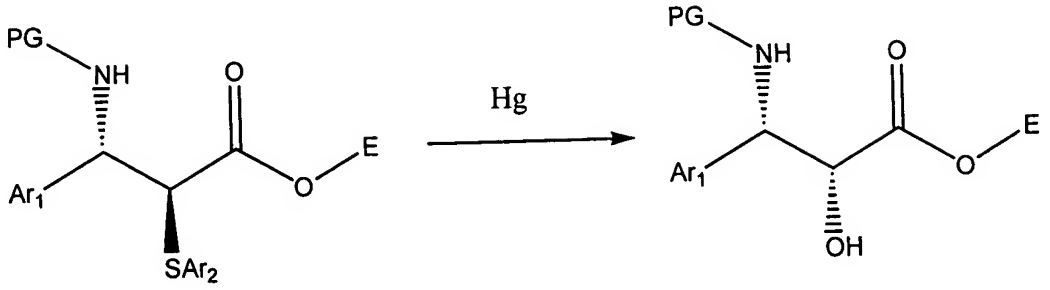
PG is a protecting group; and

salts and esters thereof.

49. The compound of claim 48 wherein R_1 is a protected hydroxyl group and the protecting group is selected from methoxymethyl, methoxyethyl, 1-ethoxyethyl, benzyloxymethyl, (beta-trimethylsilyl-ethoxy)methyl, tetrahydropyranyl, 2,2,2-trichloro-ethoxycarbonyl, benzyloxycarbonyl, *tert*-butoxycarbonyl, 9-fluorenylmethoxycarbonyl, 2,2,2-trichloroethoxymethyl, trimethylsilyl, triethylsilyl, tripropylsilyl, dimethylethylsilyl, dimethyl(t-butyl)silyl, diethylmethylsilyl, dimethylphenylsilyl, diphenylmethylsilyl, acetyl, chloroacetyl, dichloroacetyl, trichloroacetyl and trifluoroacetyl.

50. The compound of claim 48 wherein R_1 is a protected thiol group and the protecting group is selected from triphenylmethyl (trityl, Trt), acetamidomethyl (Acm), benzamidomethyl, 1-ethoxyethyl and benzoyl.

51. A process of replacing a thioaryl group with a hydroxyl group according to the scheme



wherein PG is an amine protecting group, Ar_1 and Ar_2 are aryl groups, E is hydrogen or an organic group, and Hg represents a mercury-containing oxidizing agent.

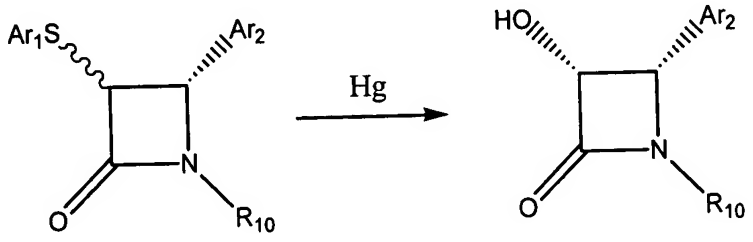
52. The process of claim 51 wherein PG is benzoyl or tBOC.

53. The process of claim 51 wherein E is hydrogen or C_1-C_6alkyl.

54. The process of claim 51 wherein Ar_1 and Ar_2 are each phenyl.

55. The process of claim 51 wherein Hg is HgO or $Hg(CF_3CO_2)_2$.

56. A process of replacing a thioaryl group with a hydroxyl group according to the scheme



wherein Hg represents a mercuric reagent, and Ar_1 and Ar_2 are independently selected from alkyl, alkenyl, alkynyl, aryl or substituted aryl radical; and R_{10} is hydrogen, C_1-C_6alkyl, aryl or substituted aryl radical; wherein a substituted aryl radical is substituted

with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms.

57. The process of claim 56 wherein Hg is mercuric oxide or mercuric trifluoroacetate.

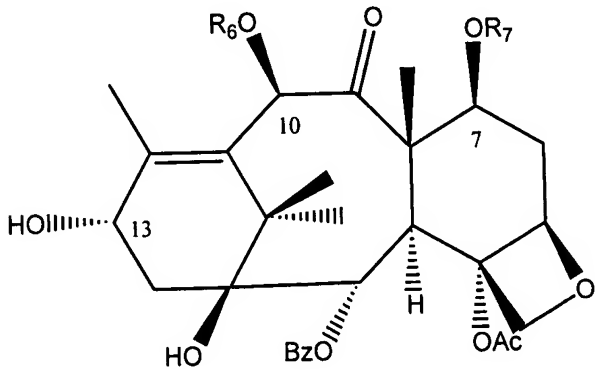
58. The process of claim 56 ceric ammonium nitrate (CAN) is utilized in the reaction.

59. The process of claim 56 wherein R_{10} is hydrogen.

60. The process of claim 56 wherein R_{10} is para-methoxyphenyl.

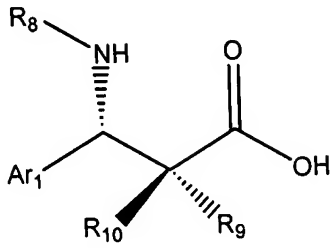
61. The process of claim 56 wherein Ar_1 and Ar_2 are each phenyl.

62. A process comprising esterifying a compound of the formula



wherein R_6 is acetyl or dichloroacetyl; and R_7 is triethylsilyl, dichloroacetyl or Troc;

with an acid compound of a formula selected from



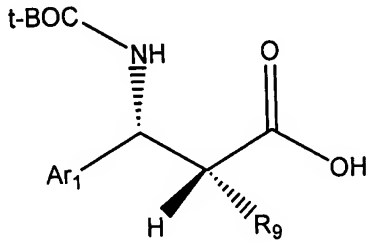
wherein

R_8 is tBOC, PMP, Bz or H;

R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, phenoxy, ethoxyethyl, or dichloroacetyl; and

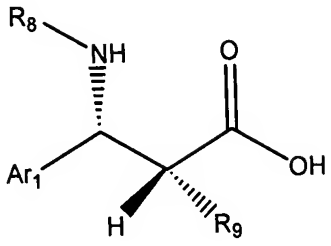
R_{10} is hydrogen.

63. The process of claim 62 wherein the acid compound has the formula



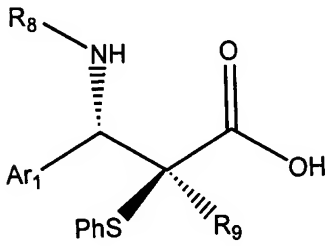
wherein Ar_1 is phenyl and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, phenoxy, ethoxyethyl, or dichloroacetyl.

64. The process of claim 62 wherein the acid compound has the formula



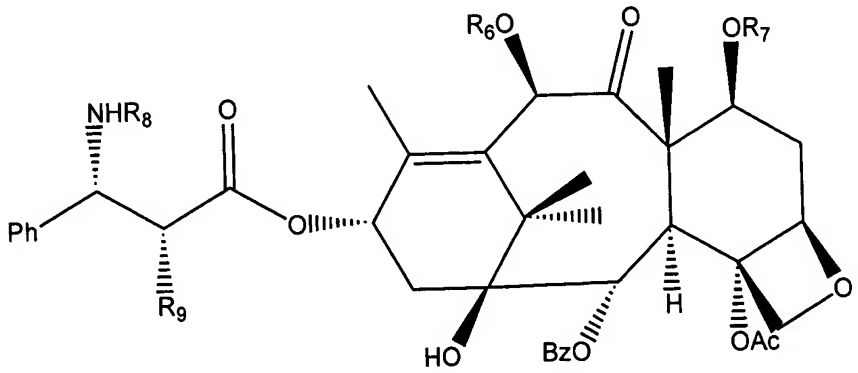
wherein Ar_1 is phenyl, R_8 is tBOC, PMP or H, and R_9 is acetoxy or a protected hydroxyl wherein the protecting group is ethoxyethyl.

65. The process of claim 62 wherein the acid compound has the formula



wherein Ar_1 is phenyl, R_8 is hydrogen or PMP, and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, phenoxy, ethoxyethyl, or dichloroacetyl.

66. A compound of the formula



wherein R_6 and R_7 are independently selected from hydrogen, triethylsilyl, acetyl and dichloroacetyl, with the proviso that R_6 and R_7 may not be simultaneously hydrogen, R_8 is tBOC, PMP, Bz or H, and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, ethoxyethyl or dichloroacetyl.

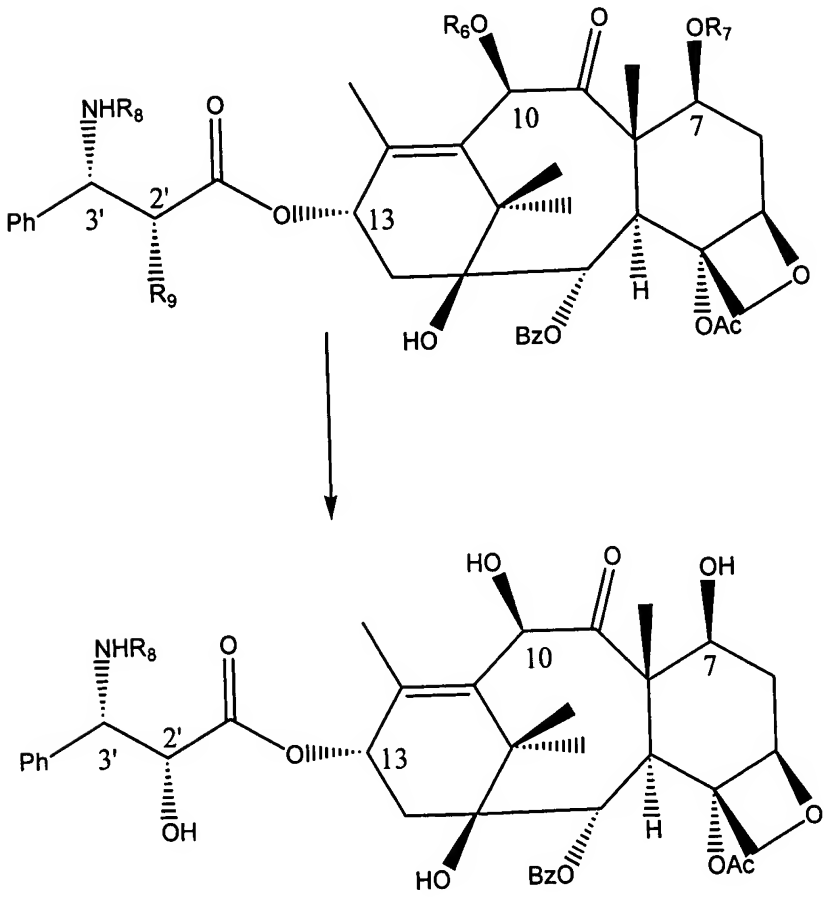
67. A compound of claim 66 wherein R_6 and R_7 are each dichloroacetyl, R_8 is tBOC and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, ethoxyethyl or dichloroacetyl.

68. A compound of claim 66 wherein R_6 is acetyl, R_7 is –TES, R_8 is t-BOC, and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, ethoxyethyl or dichloroacetoxy.

69. A compound of claim 66 wherein R_6 and R_7 are each dichloroacetyl, R_8 is tBOC, PMP or H, and R_9 is acetoxy.

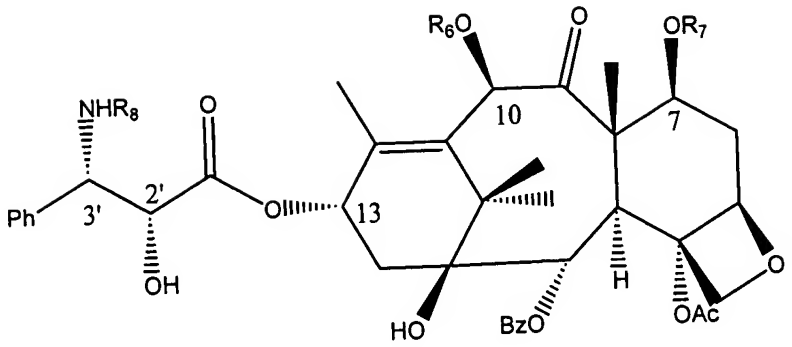
70. A compound of claim 66 wherein R_5 is triethylsilyl, R_6 is acetyl, R_8 is tBOC, PMP, Bz or H, and R_9 is acetoxy, ethoxyethyl or dichloroacetyl.

71. A process comprising the scheme



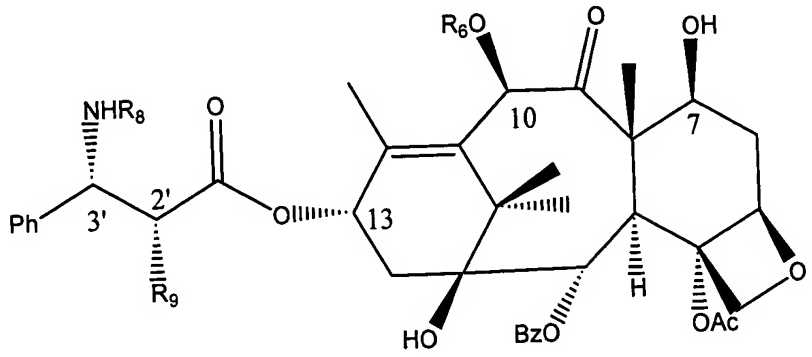
wherein R_6 and R_7 are independently selected from hydrogen, triethylsilyl, acetyl, Troc and dichloroacetyl, with the proviso that R_6 and R_7 may not be simultaneously hydrogen, R_8 is tBOC, PMP, Bz or H, and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, ethoxyethyl or dichloroacetyl.

72. The process of claim 71 wherein the compound of structure (I) is deprotected at the 2' position to form an intermediate of structure (Ia), and the intermediate is treated with zinc acetate dihydrate or urea to form the compound of formula (II), where the intermediate has the structure



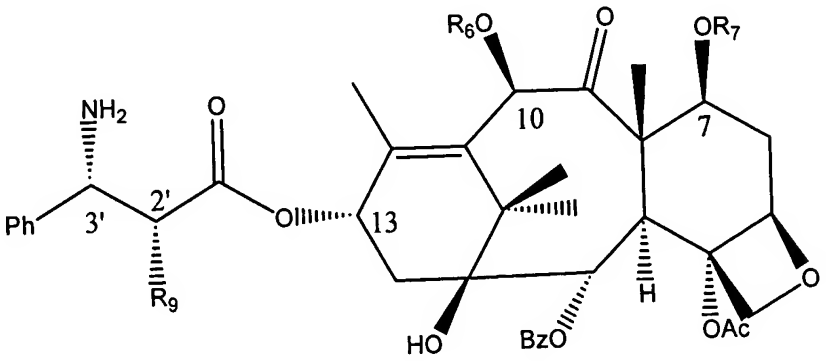
(Ia)

73. The process of claim 71 wherein the compound of formula (I) is treated with protic acid and tertiary amine in an organic solvent to form an intermediate of formula (Ib), and the intermediate is deprotected at the 2' position to form the compound of formula (II), where the intermediate has the structure



(Ib)

74. A method of preparing TAXOTERE, comprising reacting a compound of structure (III) with t-BOC, followed by deprotection of at least one of the 2', 7 and 10 positions, where the compound of structure (III) is

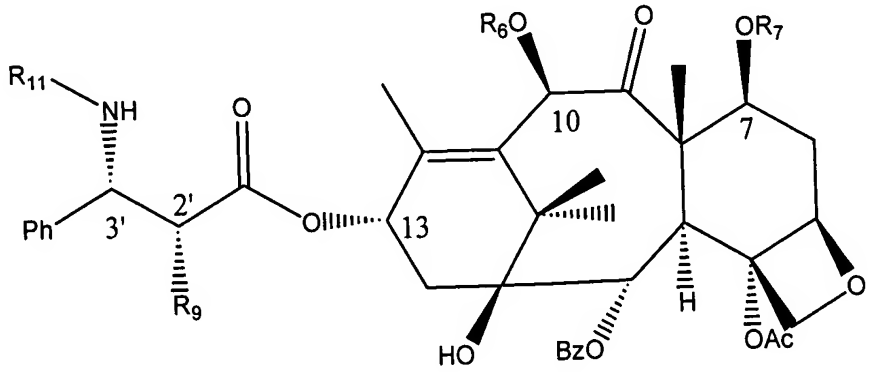


(III)

wherein R_6 and R_7 are independently selected from hydrogen, triethylsilyl, acetyl, Troc and dichloroacetyl, with the proviso that R_6 and R_7 may not be simultaneously hydrogen, and R_9 is thiophenyl, acetoxy, methoxy, t-butoxycarbonyloxy, or dichloroacetyl or ethoxyethyl.

75. The method of claim 74 wherein R_6 and R_7 are each dichloroacetyl and R_9 is acetoxy or ethoxyethyl.

76. The method of claim 75 wherein the compound of structure (III) is prepared by the reduction of a compound of structure (IV)

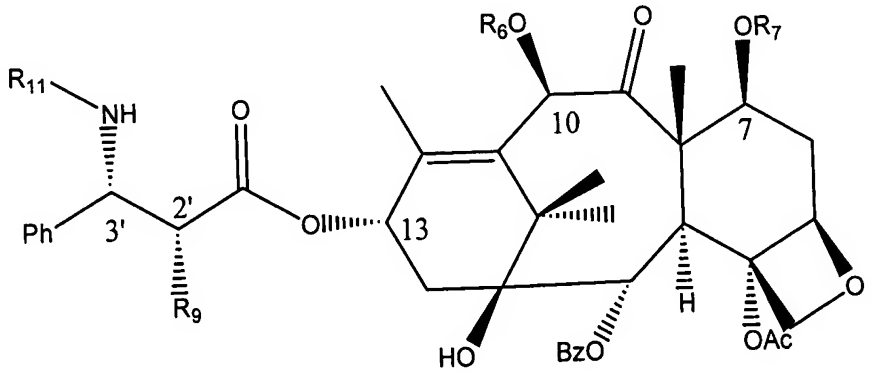


(IV)

wherein R_6 and R_7 are each dichloroacetyl, R_9 is acetoxy or ethoxyethyl, and R_{11} is OCOO-t-Bu.

77. The method of claim 74 wherein R_6 is acetyl or dichloroacetyl, R_7 is TES or Troc, and R_9 is acetoxy or ethoxyethyl.

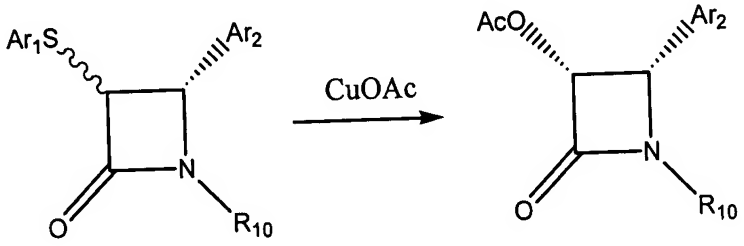
78. The method of claim 74 wherein the compound of structure (III) is prepared by the reduction of a compound of structure (IV)



(IV)

wherein R_6 is Ac, R_7 is TES, R_9 is acetoxy, and R_{11} is PMP, OCOO-t-Bu or H.

79. A process comprising the scheme



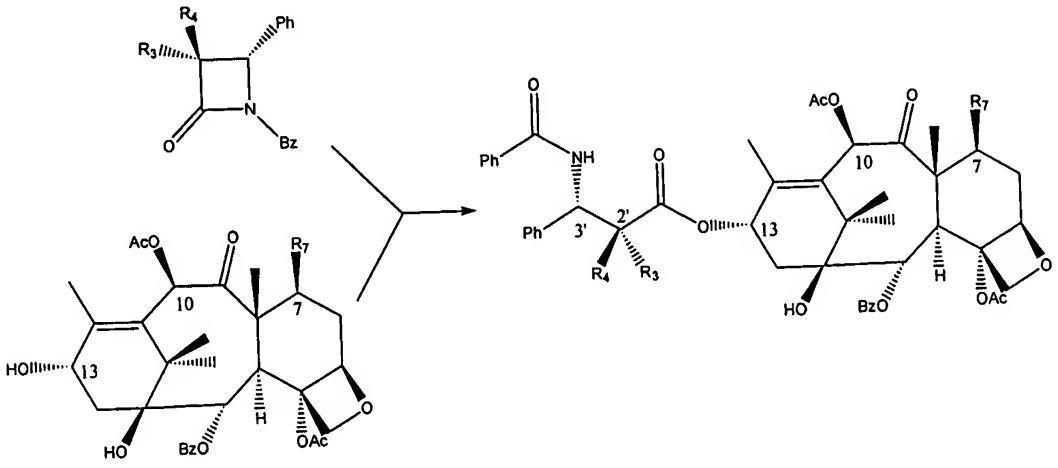
Ar_1 and Ar_2 are independently selected from alkyl, alkenyl, alkynyl, aryl or substituted aryl radical; and

R_{10} is hydrogen, C_1-C_6alkyl, aryl or substituted aryl radical;

wherein a substituted aryl radical is substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino,

mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms.

80. A process of coupling a beta lactam to a baccatin III compound according to the following scheme



wherein

R_3 and R_4 are independently selected from hydrogen, hydroxyl, protected hydroxyl, thiol, protected thiol, alkyl, alkenyl, alkynyl, or aryl where R_1 is optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

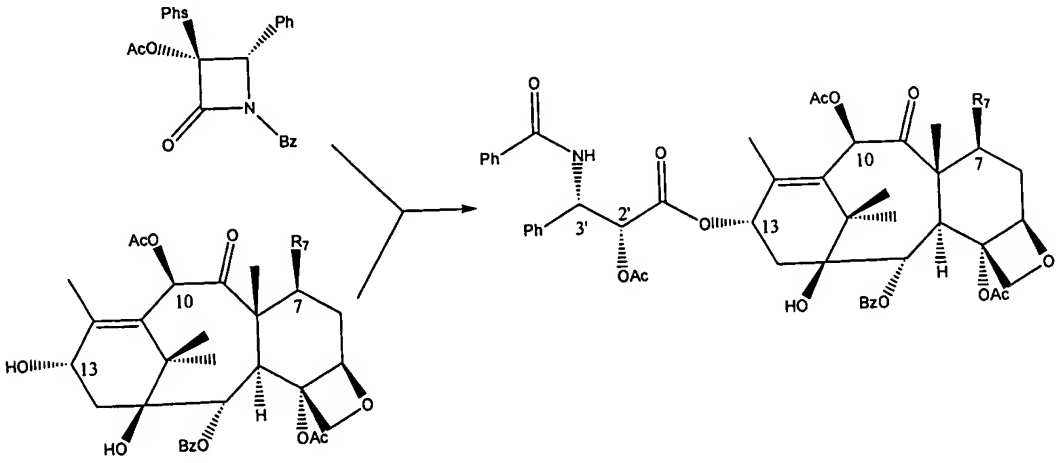
R_7 is hydroxyl or a protected hydroxyl group; and

the coupling is performed by addition of metal hydride, metal alkoxide or lewis acid to the reaction mixture.

81. The method of claim 80 wherein the coupling is performed by the addition of sodium hydride.

82. The method of claim 80 wherein the coupling is performed by the addition of sodium hexamethyldisilazide.

83. A process of coupling a beta lactam to a baccatin III compound according to the following scheme



wherein

R_3 and R_4 are independently selected from hydrogen, hydroxyl, protected hydroxyl, thiol, protected thiol, alkyl, alkenyl, alkynyl, or aryl where R_3 and R_4 are optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

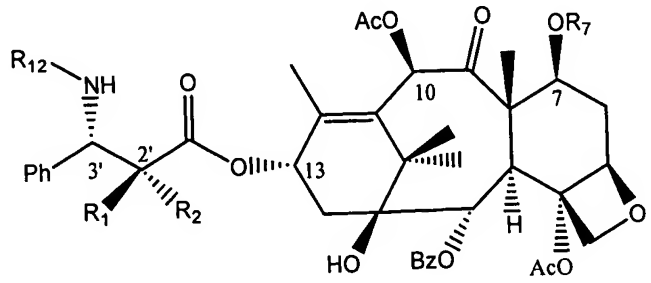
R_7 is hydroxyl or a protected hydroxyl group; and

the coupling is performed by addition of metal hydride, metal alkoxide or lewis acid to the reaction mixture.

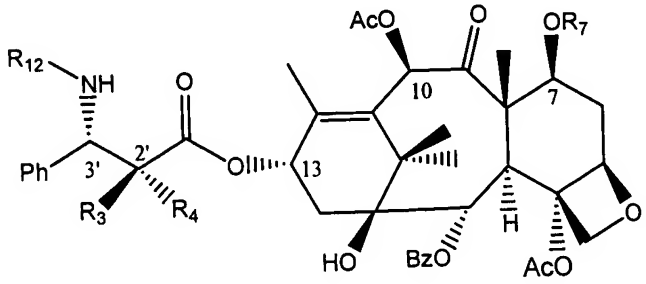
84. The method of claim 83 wherein the coupling is performed by the addition of sodium hydride.

85. The method of claim 83 wherein the coupling is performed by the addition of sodium hexamethyldisilazide.

86. A method for making a compound of formulas (III) or (IV):

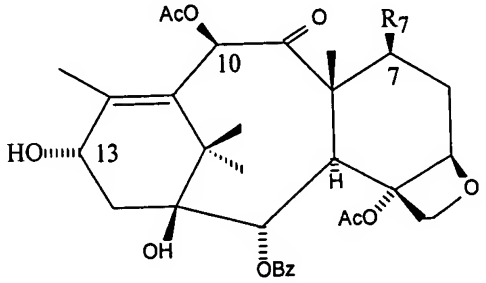


(III)



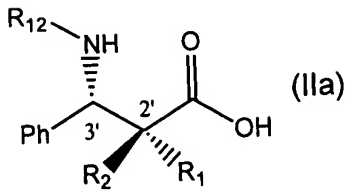
(IV)

comprising the step of reacting a compound of formula (I)

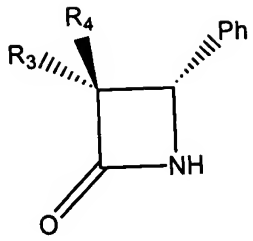


(I)

with a compound of formula (IIa) or (IIb)



(IIa)



(IIb)

wherein

R_1, R_2, R_3 and R_4 are independently selected from hydrogen, hydroxyl, protected hydroxyl, thiol, protected thiol, alkyl, alkenyl, alkynyl, or aryl where R_3 and R_4 are optionally substituted with one or more of halogen, hydroxyl, alkoxy, aryloxy, heteroaryloxy, amino, alkylamino, dialkylamino, mercapto, alkylthio, arylthio, heteroarylthio, cyano, carboxyl, alkoxycarbonyl where the alkoxy portion contains 1 to 15 carbons, aryloxycarbonyl where the aryloxy portion contains 6 to 20 carbon, or heteroarylcarbonyl where the heteroaryl portion contains 3 to 15 carbon atoms;

R_7 is -$OCOCHCl_2$ or triethylsilyl; and

R_{12} is an amine protecting group.

87. The method of claim 86 wherein the compound of formula (I) is reacted with the compound of formula (IIa).

88. The method of claim 87 wherein R_{12} is tBOC.

89. The method of claim 88 wherein R_7 is -$OCOCHCl_2$.

90. The method of claim 89 wherein R_1 is hydrogen and R_2 is thiophenyl.

91. The method of claim 89 wherein R_1 is OAc and R_2 is thiophenyl

92. The method of claim 88 wherein is R_7 is triethylsilyl.

93. The method of claim 92 wherein R_1 is hydrogen and R_2 is thiophenyl.

94. The method of claim 92 wherein R_1 is OAc and R_2 is thiophenyl

95. The method of claim 87 wherein R_{12} is benzoyl.

96. The method of claim 95 wherein R_7 is -$OCOCHCl_2$.

97. The method of claim 96 wherein R_1 is hydrogen and R_2 is thiophenyl.

98. The method of claim 96 wherein R_1 is OAc and R_2 is thiophenyl

99. The method of claim 95 wherein is R_7 is triethylsilyl.

100. The method of claim 99 wherein R_1 is hydrogen and R_2 is thiophenyl.

101. The method of claim 99 wherein R_1 is OAc and R_2 is thiophenyl

102. The method of claim 86 wherein the compound of formula (I) is reacted with the compound of formula (IIb).

103. The method of claim 102 wherein R_{12} is tBOC.

104. The method of claim 103 wherein R_7 is -$OCOCHCl_2$.

105. The method of claim 104 wherein R_3 is -OAc and R_4 is thiophenyl.

106. The method of claim 104 wherein R_3 is -OEE and R_4 is thiophenyl.

107. The method of claim 103 wherein is R_7 is triethylsilyl.

108. The method of claim 107 wherein R_3 is -OAc and R_4 is thiophenyl.

109. The method of claim 107 wherein R_3 is -OEE and R_4 is thiophenyl.

110. The method of claim 102 wherein R_{12} is benzoyl.

111. The method of claim 110 wherein R_7 is $-OCOCHCl_2$.

112. The method of claim 111 wherein R_3 is -OAc and R_4 is thiophenyl.

113. The method of claim 111 wherein R_3 is -OEE and R_4 is thiophenyl.

114. The method of claim 110 wherein is R_7 is triethylsilyl.

115. The method of claim 114 wherein R_3 is -OAc and R_4 is thiophenyl.

116. The method of claim 114 wherein R_3 is -OEE and R_4 is thiophenyl.

117. The method of claim 86 wherein the compound of formula (I) is obtained from 9-dihydro-13 acetylbaccatin III (9DHB) via baccatin III intermediate.

118. The method of claim 86 wherein the compound of formula (IIa) or (IIb) is prepared from one or more reactants selected from para-methoxyaniline,

benzaldehyde, thiophenoxyacetyl chloride, acetoxyacetyl chloride, ammonia and syn-benzaldehyde oxime.

119. The method of claim 86 wherein the compound of formula (IIa) or (IIb) comprises a thiophenyl group, and the thiophenyl group is hydrolyzed by a mercuric reagent.

120. The method of claim 119 wherein the mercuric reagent is mercuric oxide or mercuric trifluoroacetate.

121. The method of claim 86 wherein the compound of formula (III) or (IV) comprises a dichloroacetyl group, and the dichloroacetyl group is hydrolyzed by zinc acetate dihydrate or urea.

122. The method of claim 86 wherein the compound of formula (III) or (IV) comprises an acetate group, and the acetate group is removed by mild base and hydrogen peroxide.

123. The method of claim 122 wherein the mild base is sodium carbonate or sodium hydrogen carbonate.

124. The method of claim 86 wherein a paramethoxy phenyl or oxime protected t-BOC group is cleaved by reduction in an organic solvent to produce a primary amine at the 3' position.

125. The method of claim 86 further comprising the step of converting the compound of formula (III) or (IV) to paclitaxel.

126. The method of claim 86 further comprising the step of converting the compound of formula (III) or (IV) to taxotere.